(12) UK Patent Application (19) GB (11) 2 089 638 A

(21) Application No **8132100**
(22) Date of filing **23 Oct 1981**
(30) Priority data
(31) **8008596**
(32) **8 Dec 1980**
(33) **Sweden (SE)**
(43) Application published
30 Jun 1982
(51) INT CL³
A01J 5/10
(52) Domestic classification
A1M BP
(56) Documents cited
GB 1442205
(58) Field of search
A1M
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(54) Pulsator for milking machine

(57) A pulsator for a milking machine comprises four valve units (A-D) each including a first chamber adapted to be connected to a teat cup via a port (27), and valve members (17, 19) for connecting the chamber (12) alternately to a vacuum source via a chamber (11) and port (26) and to atmosphere via port (28). The valve members are adjusted by a first actuating diaphragm (15) responsive to a pneumatic control signal supplied to chamber (10) via port (25) and a second actuating diaphragm (16) responsive to the pressure in a control chamber (14) which is connected by conduits (33) under the control of a flap valve (30) to the first chambers of one or more of the other valve units. In operation the valves (17, 19) of the valve units are automatically adjusted in sequence according to the control signal pulses.

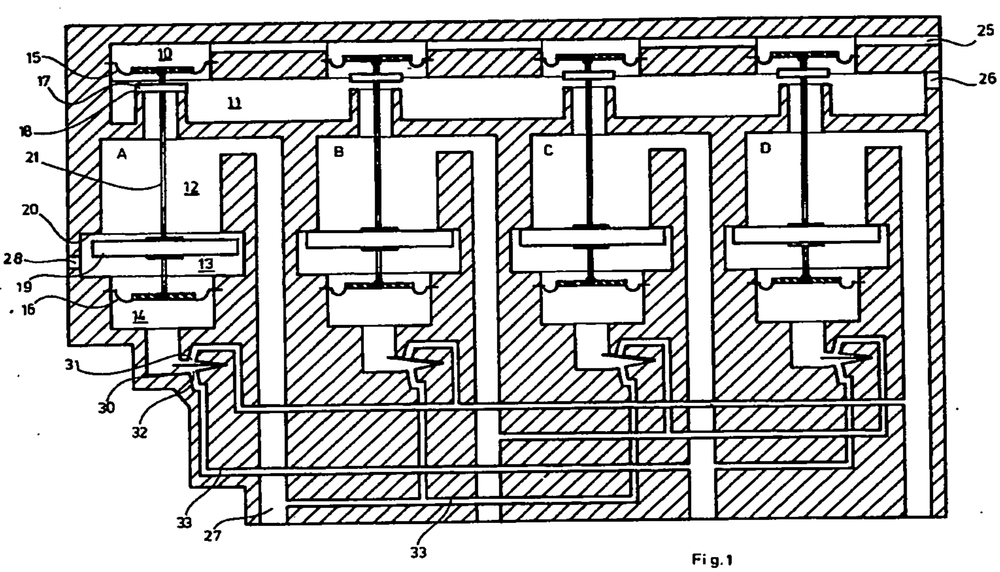

Fig.1

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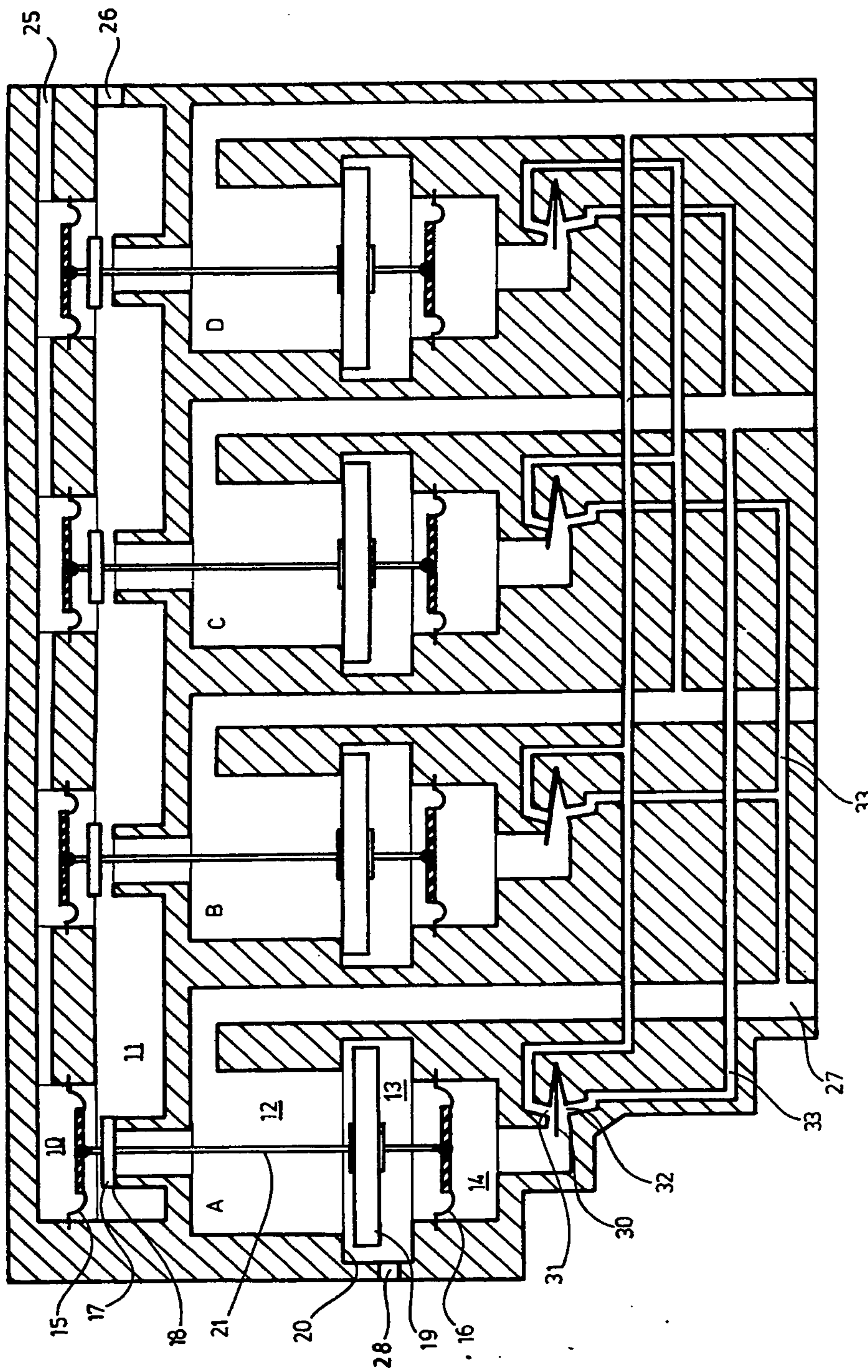

Fig.1

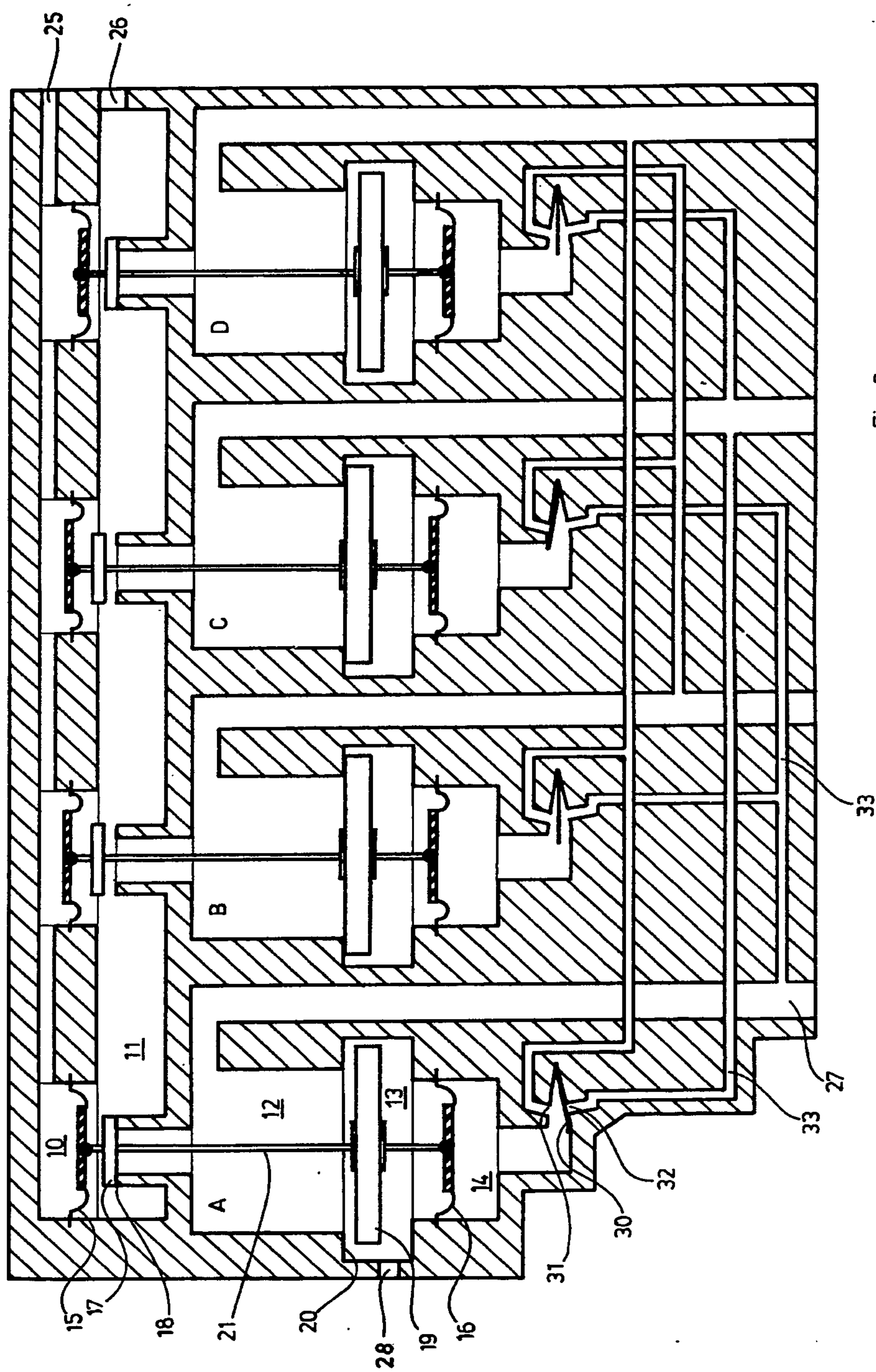

Fig.2

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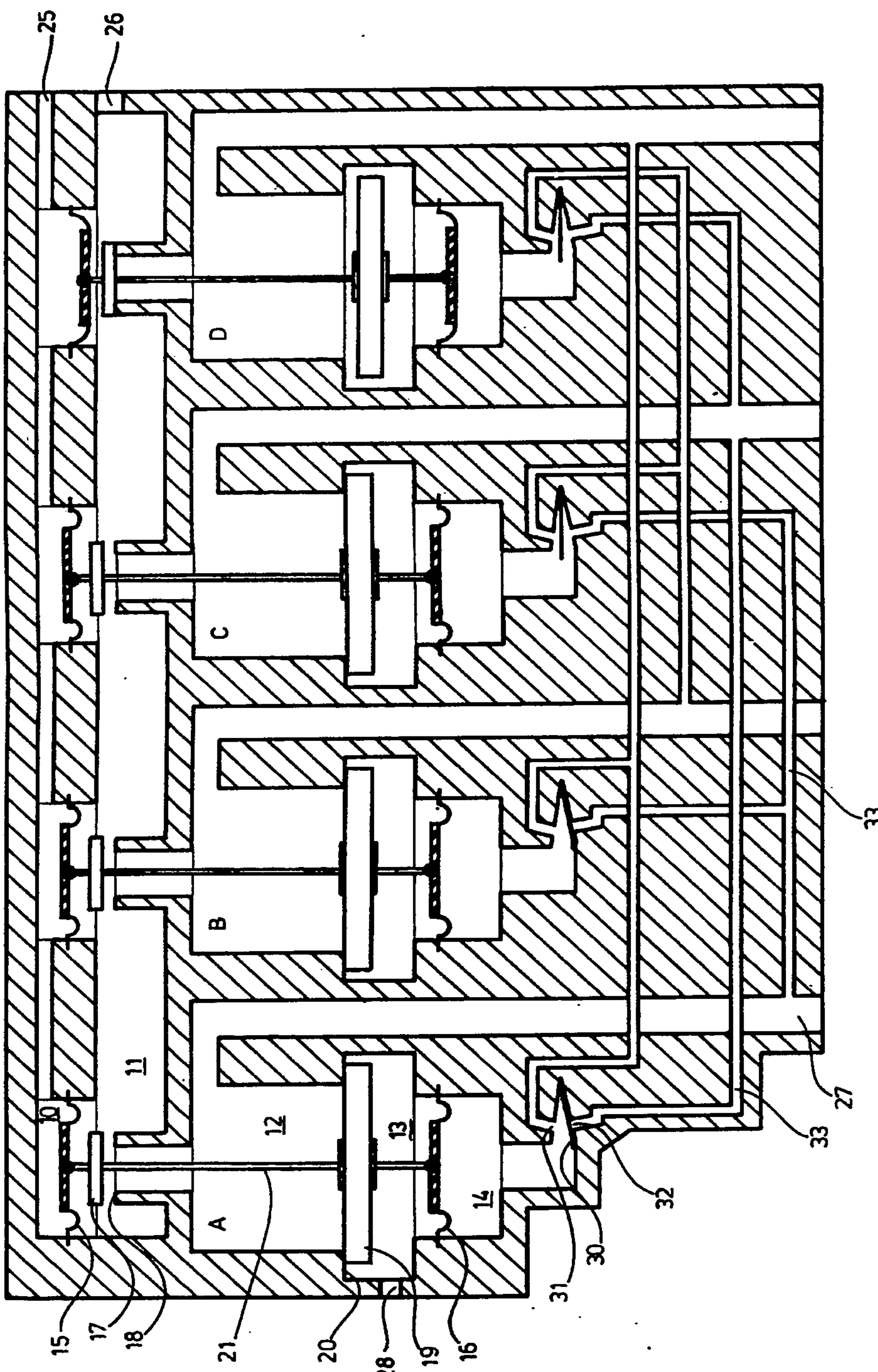

Fig. 3

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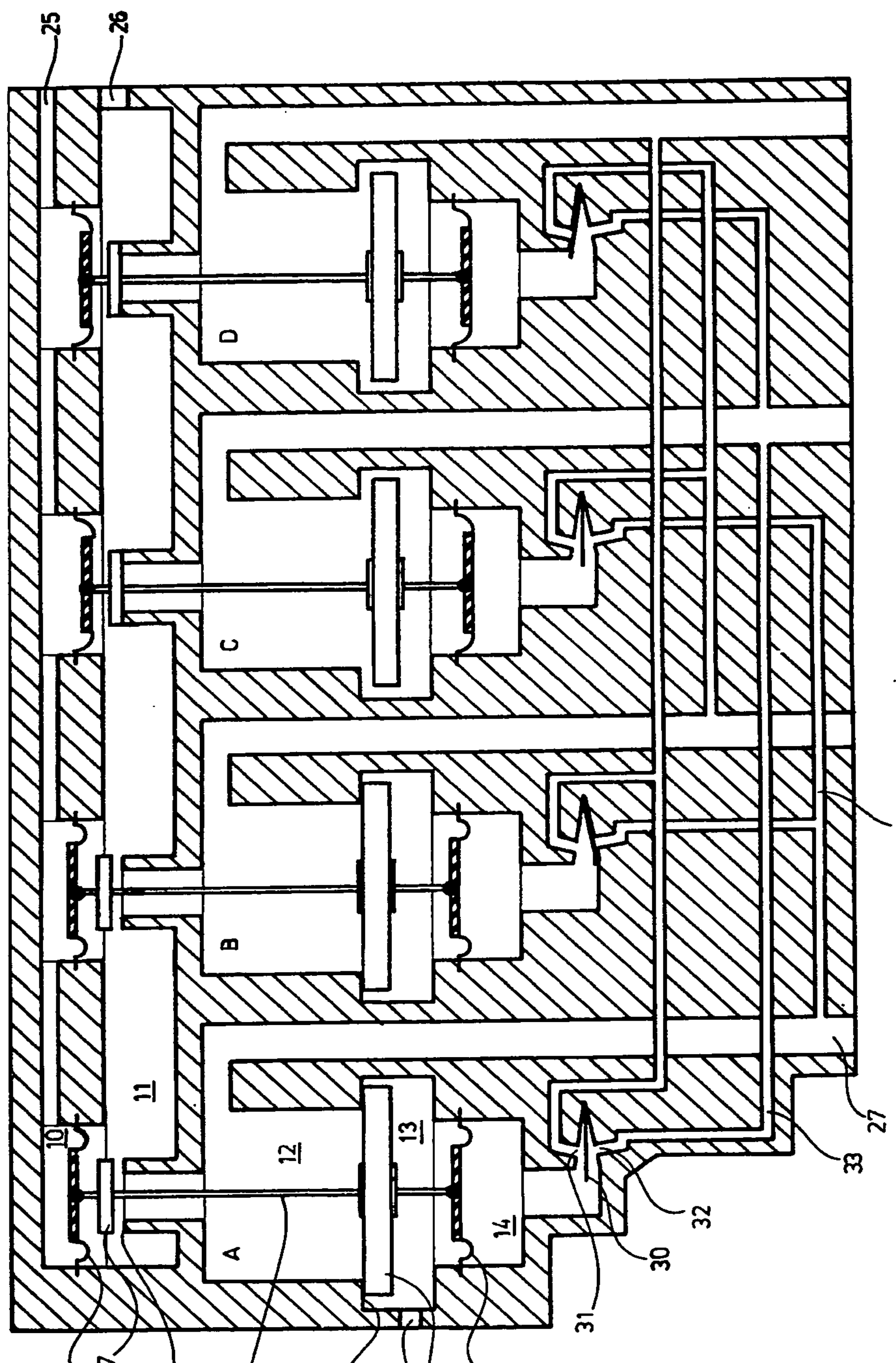

Fig. 4

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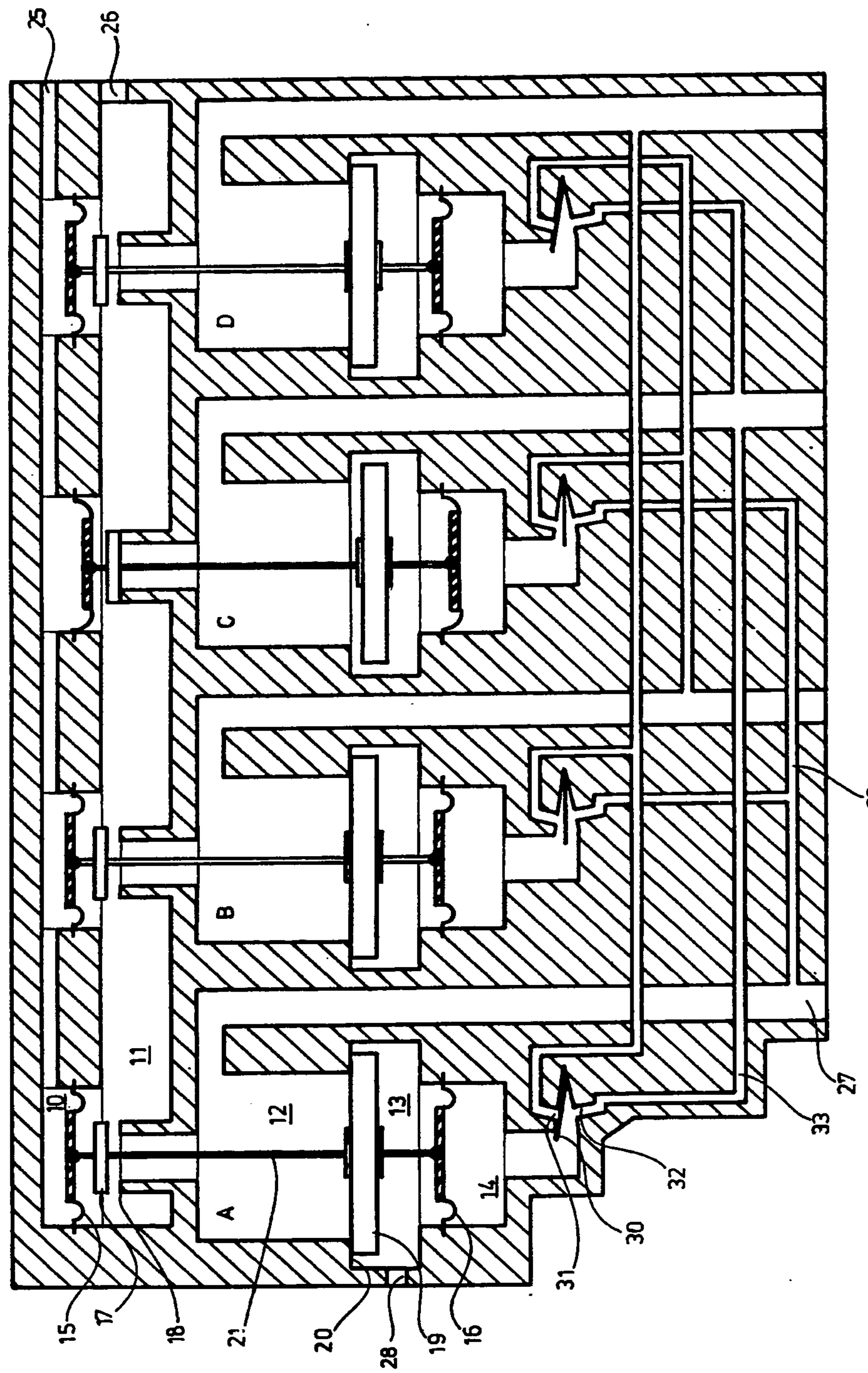

Fig.5

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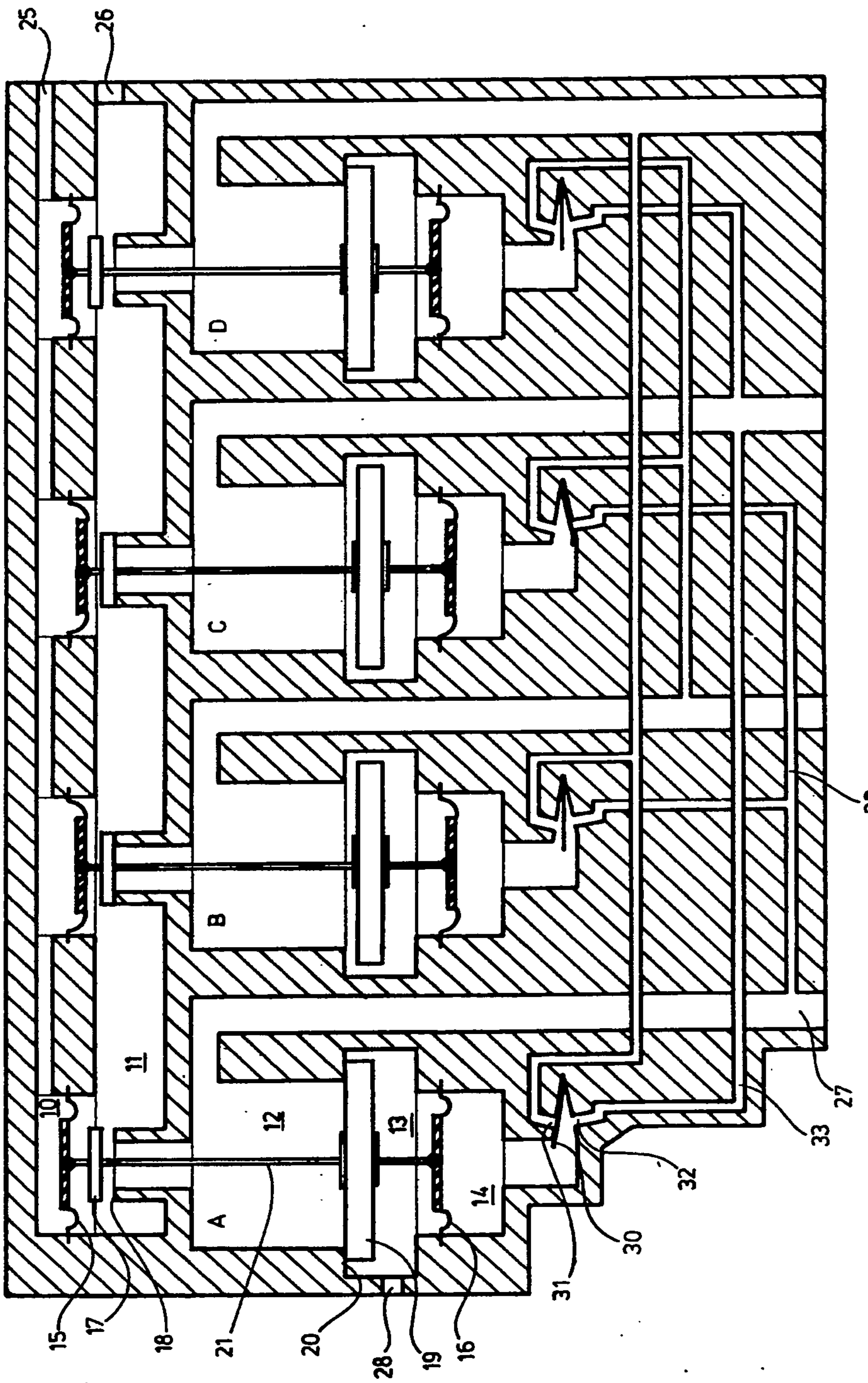

Fig. 6

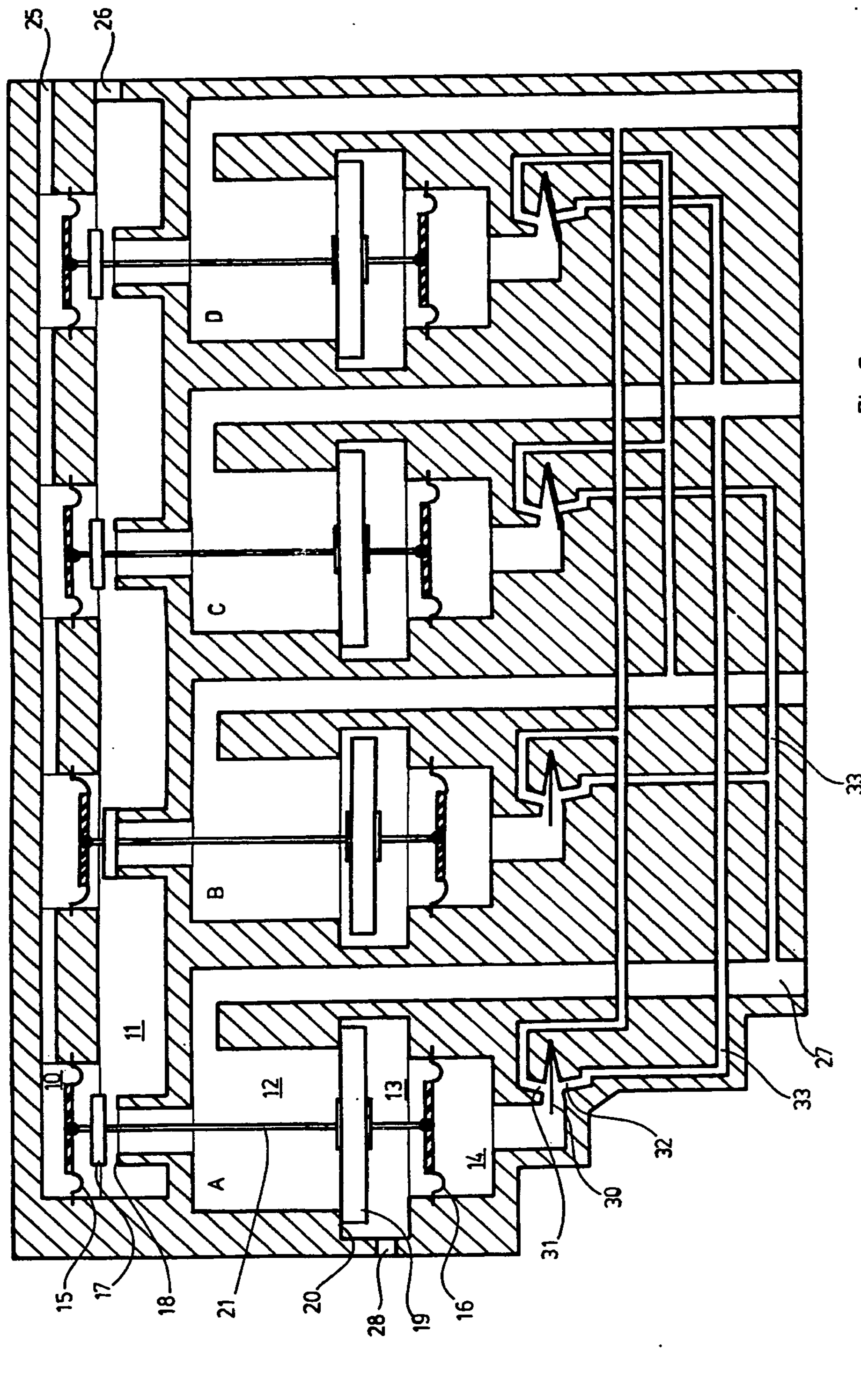

Fig.7

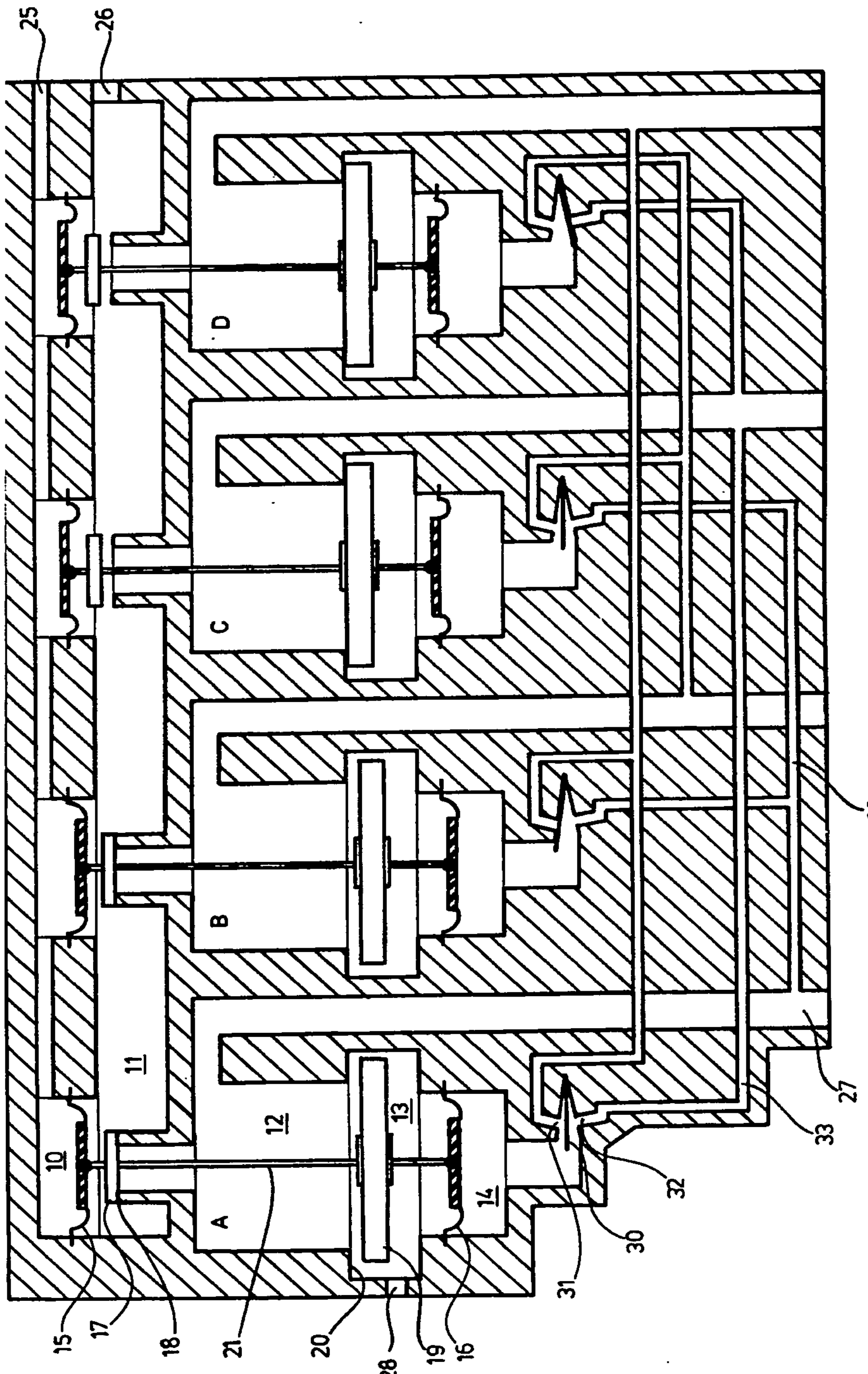

Fig.8

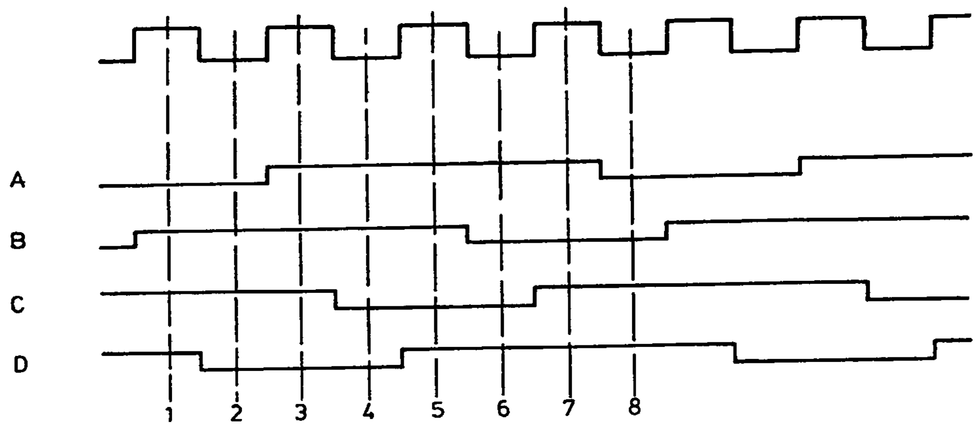

Fig. 9

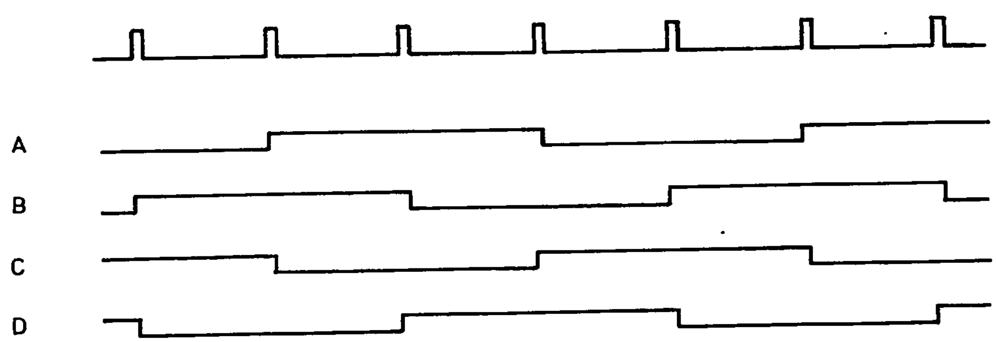

Fig. 10

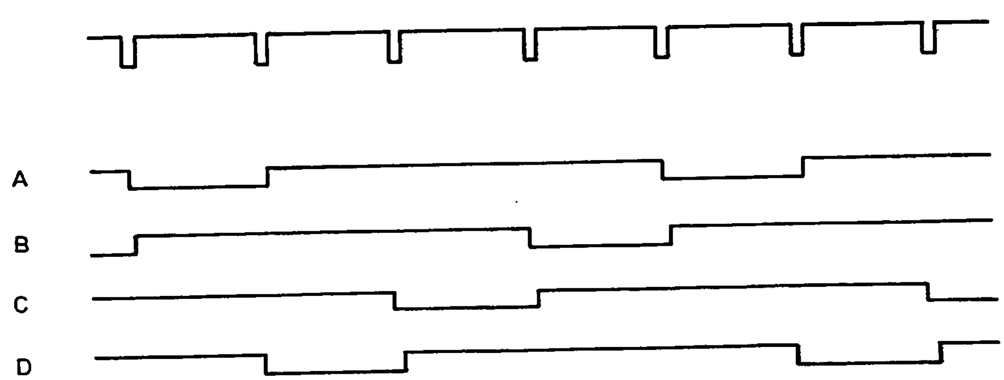

Fig. 11

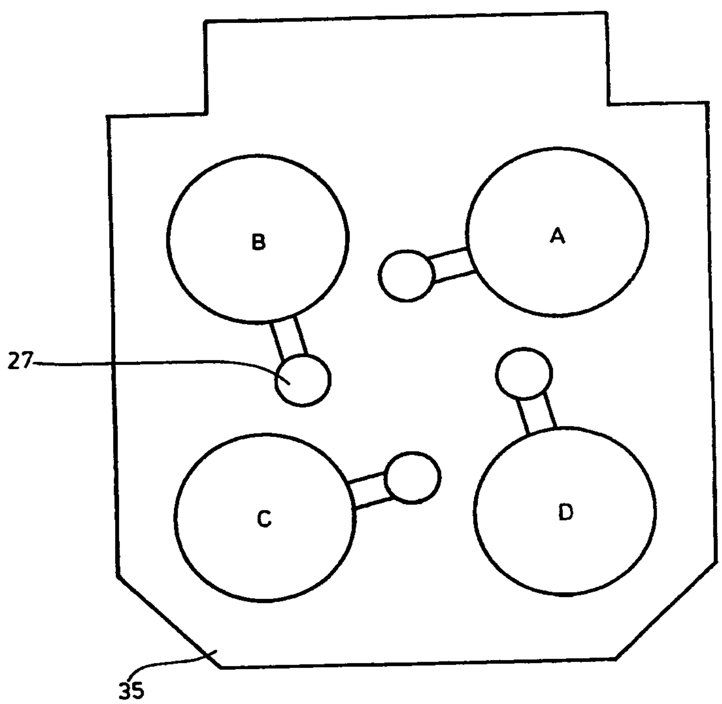

Fig. 12

SPECIFICATION

Pulsator for a milking machine

This invention relates to a pulsator for a milking machine, particularly a pulsator comprising a series of valve units for connection to respective teat cups and operable to connect each of the teat cups alternately to a vacuum source and to atmosphere, the valve units including control means for actuating the valve units in response to a pneumatic control signal alternating between vacuum and atmospheric pressure. The invention is concerned especially with a pulsator which operates with a so-called sequential pulsation, which means that the four teat cups connected to the respective valve units are actuated in a predetermined sequence.

Sequential pulsators of electronic type are known, but their utility is limited in that they are dependent on the supply of electric current. In addition, they are complicated and their manufacture is expensive, with the result that they have not been used to any large extent.

According to the present invention there is provided a pulsator for a milking machine, comprising a series of valve units for connection to respective teat cups, each valve unit including a first chamber connected to an outlet port, valve means adjustable for connecting said first chamber alternately to a vacuum souce and to atmosphere, and control means for adjusting said valve means, the control means comprising a first actuating means responsive to a pneumatic control signal, alternating between vacuum and atmospheric pressure, a second actuating means responsive to the pressure in a control chamber, and means so connecting the control chamber to the first chamber of at least one other valve unit that the valve means of the valve units are adjusted in turn in accordance with the control signal pulses.

The disadvantages of electronic pulsators are eliminated by such a pulsator, which in addition has a high reliability and an even operation without any limping. Furthermore it allows the pulsation frequency as well as the pulsation ratio to be easily adjusted.

A full understanding of the invention will be had from the following detailed description which is given below with reference to the accompanying drawings, in which:–

Figures 1 to 8 show diagrammatically a pulsator embodying the invention during successive phases of the pulsator operation;

Figures 9 to 11 illustrate graphically the operation of the pulsator with different control signals; and

Figure 12 is a diagrammatical top plan view of a pulsator according to the invention.

The pulsator shown diagrammatically in Figures 1 to 8 comprises four identical valve units designated A, B, C and D, ne for each teat cup of a milking machine. Each of the valv units is provided with a chamber 10 connected to a control vacuum source (not shown), a chamber 11 connected to a source of constant vacuum (not shown), a chamber 12 connected to a teat cup (not shown), a chamber 13 connected to the atmospher , and a lower c ntrol chamber 14 th connecti ns to which ar described below. The chambers 10 and 11 are separated by a first diaphragm 15 and the chambers 13 and 14 are separated by a second diaphragm 16.

The chamber 12 is adapted to be connected alternately to chambers 11 and 13, these connections being controlled by a first valve member 17 cooperating with a valve seat 18, and a second valve member 19 cooperating with a valve seat 20. The two valve members 17, 19 are connected together and to the two diaphragms 15, 16 by a common rod 21.

The above mentioned control vacuum source, e.g. an electric pulse relay, to which chambers 10 of the valve units A-D are connected via the common nipple 25, emits a pulsating pneumatic control signal to chambers 10. Such relays are well known and require no further description.

Chambers 11 are connected to the source of constant vacuum via a common nipple 26. Each of the chambers 12 of the valve units A-D is connected via a respective nipple 27 to the pulsation chamber of a teat cup (not shown). Chambers 13 are connected to the atmosphere via a nipple 28 which may be common for all four valve units, or each valve unit may be provided with its own nipple.

Each chamber 14 is provided at its bottom with a flap valve having a movable flap 30 controlling upper and lower valve openings 31 and 32 which are connected via a conduit system 33 to the nipples 27, and thus indirectly to the chambers 12, of two other valve units. The conduit system is arranged so that chamber 14 of valve unit A is connected via openings 31, 32 and conduits 33 to the nipples 27 of valve units D and C, respectively. Valve unit B is connected in a corrsponding manner to valve units A and D, valve unit C is connected to valve units A and B, and finally, valve unit D is connected to valve units B and C.

Regarding the effective areas of the valve members 17, 19 and diaphragms 15, 16 of each valve unit A-D, the following conditions apply:

$$19 > 15 > 17$$
$$19 > 16 > 17$$
$$15 + 16 > 19$$

The operation of the above described assembly will now be described with reference to Figures 1-9. In Figure 9, the operation of the pulsator is illustrated graphically, the upper graph indicating the pulsating control signal supplied to chamber 10, and graphs A-D representing the pressure in chamber 12, and consequently in nipple 27 of the respective valve units. As can be seen, each graph alternates between two levels, the upper one of which represents vacuum and the lower one atmospheric pressure.

In Figure 1, which corresponds to phase 1 in Figure 9, vacuum pressure is prevailing in chambers 10. Valve unit A is in its lower position, valve member 17 being closed and valve member 19 open. Chamber 12 is therefore connected to the atmosphere via nipple 28 and th valve unit emits atmosph ric pressure to its teat cup via nipple 27. The other valve units B, C and D are all in their upper positions, the upper valv member 17 being open and the lower 19 being

closed, and thus they emit vacuum via nipples 27 as their chambers 12 are connected to the vacuum s urc via nipple 26.

The pressure prevailing in the lower chamber 14 of each valve unit is determined by the pressure in nipples 27 of the other valves. A prerequisite for providing vacuum in any of chambers 14 is that the opening 31 as well as the lower 32 are connected to vacuum. In Figure 1, this is the case in valve units A and D. In valve units B and C only the upper opening 31 is connected to vacuum, flap 30 being sucked upwards towards said opening and closing it. Chambers 14 of valve units B and C are therefore supplied with atmospheric pressure from valve unit A via their lower openings 32.

When the control signal in chamber 10 is changed t atmospheric pressure, the upper diaphragms 15 are actuated thereby and endeavour to move the valves downwards. Valve unit A, however, is already in its lower position and is not adjusted. In valve units B and C, the atmospheric pressure on diaphragm 15 is counterbalanced by the atmospheric pressure in chamber 14 acting on diaphragm 16, and therefore, the positions of these valves are not changed either. In valve unit D, however, vacuum is prevailing in chamber 14, and the total force acting downwards on diaphragms 15 and 16 overcomes the force acting upwards on valve member 19. Valve unit D is therefore adjusted to the position according to Figure 2, which is indicated by phase 2 in Figure 9, and in this position emits atmospheric pressure via nipple 27. Atmospheric pressure is also conveyed therefrom to chamber 14 of valve unit A via the upper opening 31, and flap 30 moves to its lower position closing lower opening 32 which is connected to vacuum supplied from valve unit C.

When vacuum is again supplied to chambers 10, valve unit A is adjusted to its upper position due to the pressure difference acting on valve member 17. Valve units B and C are already in their upper positions. In valve unit D the upward force on valve member 17 is counteracted by the downward force on diaphragm 16 due to the vacuum pressure in chamber 14. The position of valve unit D is therefore not changed.

When valve unit A is adjusted it will emit vacuum via nipple 27. This vacuum is also conveyed to lower opening 32 of valve unit B, and said opening becomes closed by flap 30. The atmospheric pressure in chamber 14 of valve unit B is therefore not changed. Chamber 14 of valve unit C is simultaneusly connected to vacuum via opening 32. Since pening 31 is also connected to vacuum, the pressure in chamber 14 of valve unit C is changed to vacuum. The pulsator is now in the position according to Figure 3 which corresponds to phase 3 in Figure 9.

When the control signal supplied to chambers 10 is again changed to atmospheric pressure, valve unit C is adjusted to its lower p sition du to the vacuum pressure in chamber 14 thereof. Valve unit C n w emits atmosph ric pressure which causes the pressur in chamber 14 f valve unit D to be changed from vacuum t atmospheric pressure. This p sition is shown in Figure 4 and corr sp nds to phase 4 in Figure 9.

In the next phase, i.e. phase 5 in Figure 9, when the control signal to chambers 10 is changed to vacuum, valve unit D is adjusted to its upper position according to Figure 5. Valve unit D now emits vacuum, whereby the pressure in chamber 14 of valve unit B is also changed to vacuum. When the control signal is again changed to atmospheric pressure, valve unit B is therefore adjusted to its lower position according to Figure 6 and phase 6 in Figure 9. Valve unit B then emits atmospheric pressure which is also conveyed to chamber 14 of valve unit C.

When the control signal is again changed to vacuum, valve unit C is adjusted to the upper position according to Figure 7 and phase 7 in Figure 9. In this position, vacuum is emitted thereby, which is also conveyed to chamber 14 of valve unit A. When the control signal is then changed to atmospheric pressure, valve unit A is consequently adjusted to its lower position according to Figure 8 and phase 8 in Figure 9. Valve unit A then emits atmospheric pressure which is conveyed also to chamber 14 of valve unit B.

Finally, when the control signal is again changed to vacuum, valve unit B is adjusted to its upper position. In this stage, the pulsator again assumes the position indicated in Figure 1 and phase 1 in Figure 9, and thus, a full pulsation cycle has been completed.

It will be apparent from the above description that the mutual interconnection of the valve units A-D via conduits 33 and flap valves 30 ensures sequential adjustment of the valve units, i.e. the units are adjusted in turn one after the other. The pulsation frequency is controlled by the control signal illustrated graphically in Figure 9, and can therefore easily be kept constant. It can also be changed relatively easily by changing the frquency of the control signal.

In Figure 9, the time periods of the vacuum and atmospheric pressure pulses in the control signal are equal, which produces a ratio between the periods of vacuum and atmospheric pressure emitted by the pulsator of 5:3 which is equal to 1.67:1. This pulsation ratio of the pulsator can be altered as required, as will be described below.

Figure 10 illustrates a control signal graph in which the vacuum periods have been made as short as possible, and the periods of atmospheric pressure have instead been prolonged correspondingly. The length of the pulsation cycle has thus not been changed. As a result thereof, two of the valve units will be adjusted generally simultaneously but in different directions. Thus, when valve unit A is adjusted from atmospheric pressure to vacuum, valve unit C is adjusted from vacuum to atmospheric pressure. At the next vacuum period of the control signal valve unit D is adjusted from atmospheric pressure to vacuum, while valve unit B is adjusted in the opposite direction, as can easily be seen from the graphs in Figure 10. In this case, the pulsati n rati will be practically 1:1.

In the contr l signal graph shown in Figur 11 the periods f atmosph ric pressure have been mad as sh rt possible, while th vacuum periods have been prolonged c rresp ndingly. In this case also the

adjustment of two valve units takes place generally simultaneously. Thus, when valv unit D is adjusted from vacuum to atmospheric pressure, valve unit A is adjusted in the opposite direction. Further, when valve unit C is adjusted from vacuum to atmospheric pressure, valve unit D is adjusted in the opposite direction, and so on according to the graph. A control signal of such nature provides a pulsation ratio of approximatley 3:1.

As appears from the above, it is possible to change the pulsation ratio as required between the limit values 1:1 and 3:1 by varying the pneumatic control signal. The smallest possible length of the short vacuum period in Figure 10 and the atmospheric pressure period in Figure 11 will in practice be determined by how quickly the valve units A-D react to the pneumatic control pulses and will therefore be depending i.a. on the distance between the pulse relay and the pulsator. Several pulsators can be controlled from one and the same pulse relay. By changing the control signal from the pulse relay, the pulsation ratio of all pulsators connected thereto will be changed.

In Figure 12, a preferred practical embodiment of the pulsator according to the invention is illustrated diagrammatically, the valve units A-D with their outgoing nipples 27 being provided in a common housing 35.

The above described pulsator can also be used for pulsation in couples. In such case only two valve units are used, each of which being connected to two teat cups. In addition, it is possible to provide simultaneous pulsation of all four teat cups by connecting them to one and the same valve unit.

CLAIMS

1. A pulsator for a milking machine, comprising a series of valve units for connection to respective teat cups, each valve unit including a first chamber connected to an outlet port, valve means adjustable for connecting said first chamber alternately to a vacuum source and to atmosphere, and control means for adjusting said valve means, the control means comprising a first actuating means responsive to a pneumatic control signal, alternating between vacuum and atmospheric pressure, a second actuating means responsive to the pressure in a control chamber, and means so connecting the control chamber to the first chamber of at least one other valve unit that the valve means of the valve units are adjusted in turn in accordance with the control signal pulses.

2. A pulsator according to claim 1, wherein each vavle means comprises a first valve member for controlling connection between the first chamber and the vacuum source, and a second valve member which controls connection between said first chamber and atmosphere.

3. A pulsator according to claim 2, wherein there is a predetermin d rati between th effectiv areas of the valve means and f first and sec nd actuating means of th contr l means, the second valve memb r having an effective area larger than that of the first actuating means and larger than that f the sec nd actuating means, each actuating means having an effective area larger than that of the first valve member and the total effective area of both actuating m ans being larger than that of the second valve member.

4. A pulsator according to claim 1, 2 or 3, wherein the valve members and the first and second actuating means are interconnected to move together.

5. A pulsator according to any one of claims 1 to 4, wherein said connecting means connects the control chamber of each valve unit to the respective first chambers of two other valve units, and includes control valve means so controlling said connections that vacuum prevails in said control chamber only when vacuum prevails in both said respective first chambers connected thereto, atmospheric pressure otherwise prevailing in said control chamber.

6. A pulsator according to claim 5, wherein the control valve means comprises a flap cooperating with opposed valve openings connected to the respective first chambers of the other two valve units.

7. A pulsator according to any of claims 1 to 6, wherein the actuating means comprise flexible diaphragms.

8. A pulsator substantially as herein described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1982.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.